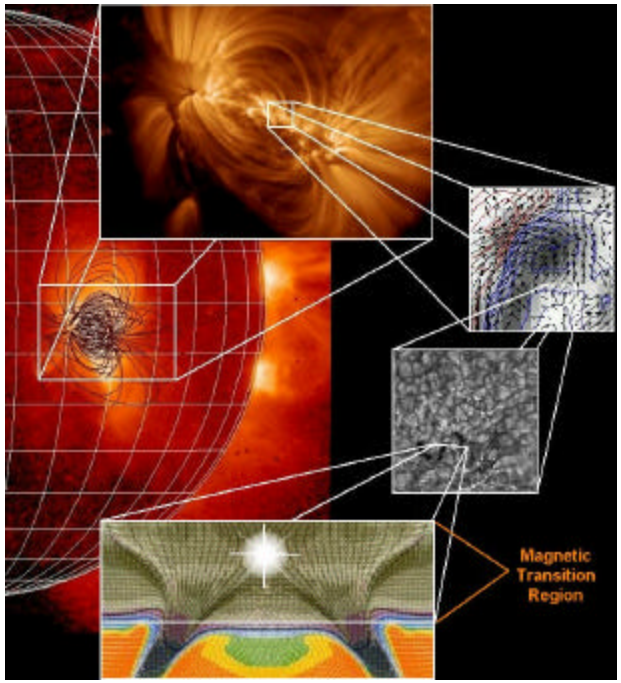
Magnetic TRAnsition region Probe (MTRAP)



***MTRAP**, a high-resolution magnetography mission, will enable us to discover and understand the structure and dynamics of the magnetic transition region from its origin in the photosphere to its effects on the corona.*

Fundamental Question: What are the physical processes operating in the magnetic transition region that transform and propagate magnetic and mechanical energy from the solar interior to restructure and heat the Sun's magnetosphere?

Why this Question is Important: The processes in the magnetic transition region are fundamental to the genesis and variability of the entire heliosphere.

Science Objectives:

- Discover, measure, and understand the 3D structure and dynamics of the magnetic transition region between the photosphere and upper chromosphere.
- Connect the structure and events in the magnetic transition region with their photospheric roots and the magnetic stressing and heating of the chromosphere and corona.
- Resolve and measure the appearance, transport, and destruction of magnetic field on the fundamental intergranular scales in the photosphere.

Mission Description:

- Sun-synchronous, Earth-orbiting satellite.
- Launch early in next decade (2013-2014).

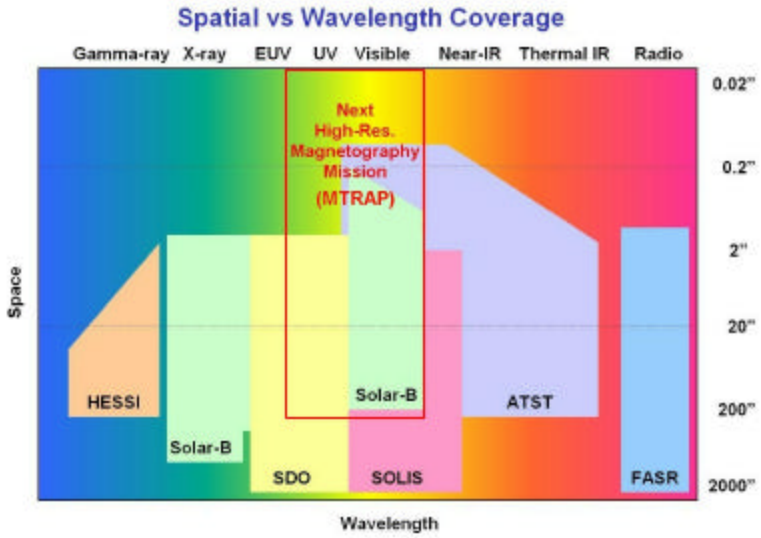
Measurement Strategy:

- Visible/infrared maps/images of vector magnetic field, intensity, and velocity in the magnetic transition region and the photosphere, with large FOV (> 100,000 km), high resolution (< 100 km), and high sensitivity (< 30 G, transverse).
- UV maps/images of line-of-sight magnetic field, intensity, and velocity in upper chromosphere/lower transition region.
- EUV images and spectra of coronal structures in and around the FOV of the magnetic transition region observations and with comparable resolution.

Technology Requirements:

- Large-aperture, light-weight solar telescopes [4 meter aperture, visible (collecting area adequate to measure full Stokes profiles in 1 second in a 0.03 arcsec (20 km) pixel), 0.5 meter aperture, EUV].
- High polarization sensitivity [polarization noise < 10^{-4} from near IR (1 μ) to far UV (100 nm)].
- Far UV optics and coatings.
- Large-format (16 k x 16 k, for170,000 km x 170,000 km FOV), high-QE, high-speed-readout cameras.
- High speed, high-resolution, image motion compensation.
- High-data-rate communication.

The Magnetic Transition Region is the relatively unexplored interface layer between the convectively dominated photosphere and the magnetically dominated upper chromosphere/inner corona. In this layer, the plasma and magnetic field are of comparable strength, which results in complex interactions. Above this layer is the Sun's magnetosphere, the region of the solar atmosphere (upper chromosphere and inner corona) in which the magnetic pressure is larger than the plasma pressure. In the magnetosphere the magnetic field imposes its structure and variability on the solar atmosphere. Fine-scale magnetic structure and events in the magnetic transition region are key to the genesis of the Sun's entire hot, dynamic outer atmosphere and to the initiation of eruptive events.



Depiction of two of the four major ways in which the next high-resolution solar magnetography mission needs to advance beyond Solar-B and the NSO Advanced Technology Solar Telescope (ATST): It should (1) observe the UV chromosphere and transition region and (2) greatly surpass Solar-B in spatial resolution. In addition it should (3) far exceed Solar-B in the sensitivity and accuracy of its magnetography, and should (4) advance beyond ATST by achieving the 0.1 arcsec resolution of ATST or better over a much larger field of view.

Recommendation from the Workshop on High-Resolution Solar Vector Magnetography from Space: Beyond Solar-B, held at the National Space Science and Technology Center in Huntsville, Alabama, 3-5 April 2001:

In view of the Workshop consensus and conclusion that (1) there is compelling scientific need for a high-resolution solar magnetography mission beyond Solar-B, and (2) this mission should focus on the 3D structure and dynamics of the magnetic field and plasma in the chromosphere and transition region, the Workshop SOC recommends the following:

1. MTRAP should be prominently featured in the 2003 SEC Roadmap as the next high-resolution solar magnetography mission after Solar-B.
2. Science & Technology Definition Teams are needed in FY04 to establish the scientific requirements and to define technology development efforts required to make the observational goals of the mission practical.
3. The necessary technology development funding should be included in Code S budgets for FY06 and beyond to prepare this mission for a new start no later than 2010.